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4.1.1. Общее земледелие и растениеводство (биологические науки, сельскохозяйственные науки)

ВЛИЯНИЕ ГУСТОТЫ СТОЯНИЯ РАСТЕНИЙ КУКУРУЗЫ НА АГРОБИОЛОГИЧЕСКИЕ ПОКАЗАТЕЛИ ЕЕ ГИБРИДОВ В ЗАВИСИМОСТИ ОТ ФОНА УДОБРЕННОСТИ

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В работе очерчен опытный материал полевых исследований по анализу реализации продуктивного потенциала гибридов кукурузы селекций КНИИСХ и Байер: раннеспелых Росс 188 МВ (ФАО 190) и ДКС 3079 (ФАО 190), средне-ранних Краснодарский 210 МВ (ФАО 210) и ДКС 3595 (ФАО 240), среднеспелых Краснодарский 377 АМВ (ФАО 370) и ДКС 4792 (ФАО 370) в зависимости от густоты стояния растений и удобрений. Предмет исследований – гибриды кукурузы. Определено, что оптимизация питательного режима растений кукурузы способствует удлинению периода вегетации на 2 дня на фоне минеральных удобрений и на 4 дня на фоне органических удобрений. Густота стояния растений у раннеспелых гибридов не влияла на данный показатель, а для остальных гибридов загущение посевов на 10 тыс. шт. на 1 га больше рекомендуемой густоты приводило к удлинению периода вегетации на 2 дня. Самыми низкорослыми являются растения раннеспелых гибридов кукурузы (Росс 188 МВ и DCK 3079) – от 171 до 207 см, против 189–215 см растений средне-ранних гибридов кукурузы (Краснодарский 210 МВ и ДКС 3595) и 194–220 см растений среднеспелых гибридов (Краснодарский 377 АМВ и ДКС 4792). При этом минеральные удобрения способствовали увеличению средней высоты растений на 3–10 см, а органические удобрения – на 8–15 см. Загущение посевов на 10 тыс. шт. на 1 га больше рекомендуемой густоты у раннеспелых гибридов приводило к вытягиванию растений в высоту на 8–14 см, у средне-ранних гибридов – на 4–14 см и у среднеспелых гибридов на 3–6 см. Уменьшение густоты стояния растений на 10 тыс. шт. на 1 га от рекомендуемой нормы у

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4.1.1. General agriculture and crop production (biological sciences, agricultural sciences)

INFLUENCE OF STANDING DENSITY OF CORN PLANTS ON AGROBIOLOGICAL INDICATORS OF ITS HYBRIDS DEPENDING ON THE FERTILIZER BACKGROUND

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The article presents experimental material from a field experiment conducted at the Department of General and Irrigated Agriculture of Kuban State Agrarian University to study the productivity of corn hybrids depending on plant density and fertilizers. Objects of research: the influence of fertilizers and standing density on the productivity of corn hybrids. The subject of research is corn hybrids of KNIISH and Bayer selections: early-ripening Ross 188 MV (FAO 190) and DKS 3079 (FAO 190), mid-early Krasnodar 210 MV (FAO 210) and DKS 3595 (FAO 240), mid - Krasnodar 377 AMV (FAO 370) and DKS 4792 (FAO 370). It was revealed that improving the nutritional conditions of corn plants helps to lengthen the growing season by 2 days with mineral fertilizers and by 4 days with organic fertilizers. The density of plant standing in early ripening hybrids did not affect this indicator, but for the remaining hybrids the density of crops was 10 thousand units. 1 hectare more than the recommended density led to an extension of the growing season by 2 days. The shortest plants are plants of early-ripening corn hybrids (Ross 188 MV and DCK 3079) - from 171 to 207 cm, against 189-215 cm of plants of mid-early corn hybrids (Krasnodar 210 MV and DKS 3595) and 194- 220 cm of plants of mid-ripening hybrids (Krasnodarsky 377 AMV and DKS 4792). At the same time, mineral fertilizers contributed to an increase in the average height of plants by 3–10 cm, and organic fertilizers – by 8–15 cm. Thickening of crops by 10 thousand units. 1 hectare more than the recommended density in early-ripening hybrids led to plants stretching in height by 8–14 cm, in mid-early hybrids – by 4–14 cm, and in mid-ripening hybrids by 3–6 cm. A decrease in plant density by 10 thousand. PC. per 1 ha of the recommended norm in early-ripening hybrids led to a decrease in the average plant

раннеспелых гибридов приводило к снижению средней высоты растений на 5–12 см, у средне-ранних гибридов – на 1–6 см и у среднеспелых гибридов на 5–7 см

height by 5–12 cm, in mid-early hybrids by 1–6 cm and in mid-ripening hybrids by 5–7 cm

Ключевые слова: КУКУРУЗА, ГИБРИДЫ, РОСС 188 МВ, ДКС 3079, КРАСНОДАРСКИЙ 210 МВ, ДКС 3595, КРАСНОДАРСКИЙ 377 АМВ, ДКС 4792, УДОБРЕНИЯ, ГУСТОТА СТОЯНИЯ, УРОЖАЙНОСТЬ

Keywords: CORN, HYBRIDS, ROSS 188 MV, DKS 3079, KRASNODAR 210 MV, DKS 3595, KRASNODAR 377 AMV, DKS 4792, FERTILIZERS, STANDING DENSITY, YIELD

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Introduction

New economic conditions and views on soil cultivation, the emergence of innovative resource-saving technical means and working bodies predetermine new research in improving methods of basic soil cultivation. The yield of field crops depends on various cultivation technologies, as well as on the use of fertilizers. [1, 6-9, 11, 12].

The use of new technologies for cultivating corn in the modern world is very important. To increase the yield of corn grain, it is necessary to use scientifically based technologies for its cultivation. Properly selected hybrids, the use of rational doses of fertilizers, and tillage together give good yield results for this crop. Correct use of fertilizers through appropriate processing allows you to obtain stable and high yields even on the weakest soils. Each element of technology carries specific tasks aimed at solving the main problems associated with growing corn. [2, 4, 5].

Corn is a strategic crop of the 21st century. It has high yield potential and is widely used in production. Almost all of its parts are used in various industries that cannot do without corn grain, and the leaves and stems are used by pulp and paper mills. Corn grain accounts for the third level of consumption, after wheat and rice[10].

Besides,At present, an acute problem has arisen associated with environmental pollution and a decrease in soil fertility. Intensive use of mineral fertilizers greatly depletes the soil, reducing the humus layer, and replenishment

with organic fertilizers practically does not occur, the share of the use of organic fertilizers in Krasnodar does not exceed 1% and there is practically nothing to replenish [3].

Material and object of research

Research years – 2021-2023. The experimental field is a flat terrain with depressions in which water usually stagnates in the spring. According to geomorphological zoning, the territory of the Kuban educational farm is included in the Kuban delta region, represented by the Pre-Kuban Plain, and also belongs to the forest-steppe and steppe zone of the Cis-Caucasian forest-steppe province. The land plot is located on the right bank of the river. Kuban, on the first terrace above the floodplain. The percentage of humus in the soil is on average 3.3%, can be traced up to one and a half meters deep, due to which the reserves of gross humus can reach up to 400 t/ha, and in a two-meter layer can reach up to 500 t/ha. The arable layer of leached chernozem contains a powdery structure, and the subarable layer has a cloddy-grained structure. The mechanical composition of these soils is heavy, with weak compaction. A peculiarity of leached chernozem was noticed from a depth of 47 cm - boiling from 10% hydrochloric acid. The reaction of the soil solution is more inclined to be neutral, but it can also be slightly acidic (pH = 6,5-6,9). Soils such as leached chernozem are characterized by a clayey mechanical composition. Leached chernozem has a heavy mechanical composition, good structure, granular and fine-grained fractions. The ratio of capillary to non-capillary porosity is 3: 1. Chernozems are soils of flat plains with high fertility; they are considered the best for growing most agricultural crops. Leached chernozems are common in the central part of the Krasnodar Territory and make up about 93.2% of the earth's surface.

Research was carried out on corn hybrids of the KNIISH and Bayer selections: early-ripening Ross 188 MV (FAO 190) and DKS 3079 (FAO 190),

mid-early Krasnodar 210 MV (FAO 210) and DKS 3595 (FAO 240), mid-season Krasnodar 377 AMV (FAO 370) and DKS 4792 (FAO 370).

Research methods

Experiment scheme.3-factor experience.

Factor A – background fertilization.

1. Without fertilizers (control). 2. Recommended rate of mineral fertilizer (N80P80K80 + N30). 3. Biofertilizer (10 t/ha).

Factor B – corn hybrids (6 hybrids).

Factor C – plant density.

*For early ripening hybrids:*1. 60 thousand pieces/ha. (-10). 2. 70 thousand pieces/ha (control). 3. 80 thousand pieces/ha. (+10).

*For mid-early hybrids:*1. 55 thousand pieces/ha. (-10). 2. 65 thousand pieces/ha (control). 3. 75 thousand pieces/ha. (+10).

*For mid-season hybrids:*1. 50 thousand pieces/ha. (-10). 2. 60 thousand pieces/ha (control). 3. 70 thousand pieces/ha. (+10).

Methods and agricultural technology are generally accepted. Number of options – 108. Area of experiment – 0.93 hectares. The total area of the plot is 2.8 × 10 m = 28 m2, incl. accounting – 1.4 × 10 m = 14 m2. The experiment was carried out in triplicate. The location of the plots is systematic. The predecessor is winter wheat.

Results and its discussion

The duration of the growing season is determined by the varietal characteristics and conditions of the growing phases. In order to carry out plant care work correctly, it is important to know the phases of the growing season of crops. The length of the growing season of a cultivated plant is under pressure from environmental conditions and the genetic inclinations of the genotype. The growing season is the time required to complete the full cycle of growth and

development of a plant. The influence of factors, such as varietal characteristics and growing conditions, determine the duration of this period. For corn, the start dates for the following phases were established: germination, panicle flowering, cob flowering, grain filling and full ripeness.

Phenological observation data are presented in Table 1.Our phenological observations of corn plants revealed some differences in the dates of the onset of the main phases of growth and development of the crop and showed that the amount of fertilizer applied and the plant density do not affect the rate of emergence of seedlings. When sowing on April 26, in all variants, seedlings were noted from May 6. The earliest to begin flowering were the ears of early-ripening corn hybrids (Ross 188 MV and DCK 3079) - from July 1 to 4, followed by the ears of mid-early corn hybrids (Krasnodarsky 210 MV and DKS 3595) - from July 5 to July, and the last to start for flowering, the ears of plants of mid-season hybrids (Krasnodar 377 AMV and DKS 4792) - from July 8 to July 12. At the same time, mineral fertilizers delayed the flowering of cobs by 1 day, and organic fertilizers – by 2 days. The density of plant standing in early ripening hybrids did not affect this indicator, but for the remaining hybrids the density of crops was 10 thousand units. 1 hectare more than the recommended density led to a delay in flowering of the cobs by 1 day.

Table 1 – Flowering dates for corn cobs

Corn hybrids	Fertilizer background								
	no fertilizers			mineral fertilizer			organic fertilizer		
	standing density, thousand pieces for 1 hectare.								
	-10	To	+10	-10	To	+10	-10	To	+10
early ripeness group									
Ross 188 MV	02.07	02.07	02.07	03.07	03.07	03.07	04.07	04.07	04.07
DCK 3079	01.07	01.07	01.07	02.07	02.07	02.07	03.07	03.07	03.07

mid-early ripeness group									
Krasnodarsky 210 MV	05.07	05.07	06.07	06.07	06.07	07.07	07.07	07.07	08.07
DKS 3595	06.07	06.07	07.07	07.07	07.07	08.07	08.07	08.07	09.07
middle ripeness group									
Krasnodarsky 377 AMV	09.07	09.07	10.07	10.07	10.07	11.07	11.07	11.07	12.07
DKS 4792	08.07	08.07	09.07	09.07	09.07	10.07	10.07	10.07	11.07

Note: sowing – 22.04, germination – 06.05.

- *– j – recommended plant density;*
- *– -10 – per 10 thousand pieces. 1 ha less than recommended density;*
- *– +10 – for 10 thousand pieces. 1 hectare more than the recommended density.*

The earliest physiological ripeness of cobs occurred in plants of early-ripening corn hybrids (Ross 188 MV and DCK 3079) - from August 16 to 20, followed by plants of mid-early corn hybrids (Krasnodarsky 210 MV and DKS 3595) - from August 20 to 26 and The last to reach physiological ripeness were the ears of plants of mid-season hybrids (Krasnodarsky 377 AMV and DKS 4792) - from August 31 to September 9 (Table 2).

Table 2 – Dates of physiological ripeness of corn cobs

Corn hybrids	Fertilizer background								
	no fertilizers			mineral fertilizer			organic fertilizer		
	standing density*, thousand pieces for 1 hectare.								
	-10	To	+10	-10	To	+10	-10	To	+10
early ripeness group									
Ross 188 MV	16.08	16.08	16.08	18.08	18.08	18.08	20.08	20.08	20.08
DCK 3079	15.08	15.08	15.08	17.08	17.08	17.08	19.08	19.08	19.08

mid-early ripeness group									
Krasnodarsky 210 MV	20.08	20.08	22.08	22.08	22.08	24.08	24.08	24.08	26.08
DKS 3595	22.08	22.08	24.08	24.08	24.08	26.08	26.08	26.08	28.08
middle ripeness group									
Krasnodarsky 377 AMV	02.09	02.09	04.09	04.09	04.09	06.09	06.09	06.09	08.09
DKS 4792	31.08	31.08	02.09	02.09	02.09	04.09	04.09	04.09	06.09

Note: Sowing – 22.04. Shoots – 06.05.

- *– j – recommended plant density;*
- *– -10 – per 10 thousand pieces. 1 ha less than recommended density;*
- *– +10 – for 10 thousand pieces. 1 hectare more than the recommended density.*

At the same time, mineral fertilizers delayed the onset of physiological ripeness of the cobs by 2 days, and organic fertilizers – by 4 days.

The density of plant standing in early ripening hybrids did not affect this indicator, but for the remaining hybrids the density of crops was 10 thousand units. 1 hectare more than the recommended density led to a delay of this phase by 2 days.

Data on the duration of the growing season are presented in Table 3. The shortest growing season was for plants of early ripening corn hybrids (Ross 188 MV and DCK 3079) - 102-106 days, followed by plants of mid-early corn hybrids (Krasnodar 210 MV and DKS 3595) - 106-112 days and the longest period the vegetation period was 117-125 days for plants of mid-season hybrids (Krasnodarsky 377 AMV and DKS 4792).

Table 3 – Duration of periods of growth and development of corn plants, days

Corn hybrids	Fertilizer background								
	no fertilizers			mineral fertilizer			organic fertilizer		
	standing density, thousand pieces for 1 hectare.								
	-10	To	+10	-10	To	+10	-10	To	+10
early ripeness group									
Ross 188 MV	102	102	102	104	104	104	106	106	106
DCK 3079	101	101	101	103	103	103	105	105	105
mid-early ripeness group									
Krasnodarsky 210 MV	106	106	108	108	108	110	110	110	112
DKS 3595	108	108	110	110	110	112	112	112	114
middle ripeness group									
Krasnodarsky 377 AMV	119	119	121	121	121	123	123	123	125
DKS 4792	117	117	119	119	119	121	121	121	123

At the same time, mineral fertilizers increased the growing season by 2 days, and organic fertilizers – by 4 days.

The density of plant standing in early ripening hybrids did not affect this indicator, but for the remaining hybrids the density of crops was 10 thousand units. 1 hectare more than the recommended density led to an extension of the growing season by 2 days.

Data on the biometric characteristics of corn plants are presented in Table 4.

Table 4 – Height of corn plants, cm

Corn hybrids	Fertilizer background								
	no fertilizers			mineral fertilizer			organic fertilizer		
	standing density, thousand pieces for 1 hectare.								
	-10	To	+10	-10	To	+10	-10	To	+10
early ripeness group									
Ross 188 MV	171	184	192	181	192	206	181	193	207
DCK 3079	176	181	190	182	187	196	186	191	198
mid-early ripeness group									
Krasnodarsky 210 MV	194	201	207	202	207	211	205	211	215
DKS 3595	189	193	196	196	202	211	203	204	205
middle ripeness group									
Krasnodarsky 377 AMV	199	207	211	205	211	217	211	217	220
DKS 4792	194	201	206	201	206	210	206	212	217

Studying the height of corn plants, we came to the conclusion that the shortest plants were plants of early ripening corn hybrids (Ross 188 MV and DCK 3079) - from 171 to 207 cm, followed by plants of mid-early corn hybrids (Krasnodar 210 MV and DKS 3595) - from 189 to 215 cm and the tallest plants were mid-season hybrids (Krasnodarsky 377 AMV and DKS 4792) - from 194 to 220 cm.

At the same time, mineral fertilizers contributed to an increase in the average height of plants by 3-10 cm, and organic fertilizers - by 8-15 cm.

Biometric studies showed that the shortest plants were plants of early-ripening corn hybrids (Ross 188 MV and DCK 3079) - from 171 to 207 cm, followed by plants of mid-early corn hybrids (Krasnodar 210 MV and DKS

3595) - from 189 to 215 cm and The tallest plants were plants of mid-season hybrids (Krasnodar 377 AMV and DKS 4792) - from 194 to 220 cm.

At the same time, mineral fertilizers contributed to an increase in the average height of plants by 3-10 cm, and organic fertilizers - by 8-15 cm.

The density of plant standing had a greater influence on the height of corn plants. In early-ripening hybrids, the crops are thickened by 10 thousand units. 1 hectare more than the recommended density led to plants stretching in height by 8-9 cm on an unfertilized background, by 9-14 cm on a background of mineral fertilizers, and by 7-14 cm on a background of organic fertilizers.

In mid-early hybrids, crops are thickened by 10 thousand units. 1 hectare more than the recommended density led to plants stretching in height by 4-7 cm on an unfertilized background, by 9-14 cm on a background of mineral fertilizers, and by 7-14 cm on a background of organic fertilizers.

Mid-season hybrids have thickened crops by 10 thousand units. 1 hectare more than the recommended density led to plants stretching in height by 4-5 cm on an unfertilized background, by 4-6 cm on a background of mineral fertilizers and by 3-5 cm on a background of organic fertilizers.

In early ripening hybrids, the plant density decreases by 10 thousand units. per 1 hectare from the recommended norm led to a decrease in the average height of plants by 5-13 cm on an unfertilized background, by 5-11 cm on a background of mineral fertilizers and by 5-12 cm on a background of organic fertilizers.

In mid-early hybrids, the plant density decreases by 10 thousand units. per 1 hectare from the recommended norm led to a decrease in the average height of plants by 4-6 cm on an unfertilized background, by 5-6 cm on a background of mineral fertilizers and by 1-6 cm on a background of organic fertilizers.

In mid-season hybrids, the plant density decreases by 10 thousand units. per 1 hectare from the recommended norm led to a decrease in the average

height of plants by 7-8 cm on an unfertilized background, by 5-6 cm on a background of mineral fertilizers and by 6 cm on a background of organic fertilizers.

conclusions

It was determined that optimization of the nutritional regime helps to lengthen the growing season by 2 days against the background of mineral fertilizers and by 4 days against the background of organic fertilizers. The density of plant standing in early ripening hybrids did not affect this indicator, but for the remaining hybrids the density of crops was 10 thousand units. 1 hectare more than the recommended density led to an extension of the growing season by 2 days. The shortest plants are the plants of early-ripening corn hybrids (Ross 188 MV and DCK 3079) - from 171 to 207 cm, against 189-215 cm of plants of mid-early corn hybrids (Krasnodarsky 210 MV and DKS 3595) and 194-220 cm of plants of mid-ripening hybrids (Krasnodarsky 377 AMV and DKS 4792). At the same time, mineral fertilizers contributed to an increase in the average height of plants by 3–10 cm, and organic fertilizers – by 8–15 cm. Thickening of crops by 10 thousand units. 1 hectare more than the recommended density in early-ripening hybrids led to plants stretching in height by 8–14 cm, in mid-early hybrids – by 4–14 cm, and in mid-ripening hybrids by 3–6 cm. A decrease in plant density by 10 thousand. PC. per 1 ha of the recommended norm in early-ripening hybrids led to a decrease in the average plant height by 5–12 cm, in mid-early hybrids by 1–6 cm and in mid-ripening hybrids by 5–7 cm.

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